

1. Any kind of word problem. We are always surprised at how many students have trouble with even simple addition & subtraction especially if the problem is in words.

a) Determine the number of neutrons (n) if given the protons (p) and mass.

$$p + n = \text{Mass}$$

b) The volume of water in a graduated cylinder goes from 12 mLs to 21 mLs when a solid object weighing 15 g is put in the cylinder.

- Determine the volume of the object.
- Determine the density of the object given $D=M/V$.

2. Basic log function knowledge: algebraic handling of log (ln) functions i.e. how to eliminate a log (anti-log).

$$x = -\log y \text{ and } 10^{-y} = x$$

a) The hydrogen ion concentration $[H_3O^+]$ in a solution is 2.9×10^{-5} . What is the pH of this solution, where $pH = -\log[H_3O^+]$?

b) The pH of a solution is 9.2. What is the $[H_3O^+]$ ion concentration if $pH = -\log[[H_3O^+]$?

c) Benzene has a vapor pressure of 183 mmHg at 40°C . Taking its heat of vaporization to be 30.8 kJ/mol, calculate its vapor pressure at 25°C . Where $R=8.31 \text{ J/mol}\cdot\text{K}$

$$\ln\left(\frac{P_1}{P_2}\right) = -\frac{\Delta H}{R} \left[\left(\frac{1}{T_1}\right) - \left(\frac{1}{T_2}\right) \right] \text{ Solve for } P_2$$

(or solve for T_1 if given different information)

3. Solve for n_1 or n_2 etc.:

a) An electron in the $n=5$ level of an H atom emits a photon of wavelength 1281 nm. To what energy level does the electron move?

$$\text{Where } R = 1.097 \times 10^8 \text{ nm}^{-1}$$

$$\frac{1}{\lambda} = R \left[\left(\frac{1}{n_1^2}\right) - \left(\frac{1}{n_2^2}\right) \right],$$

4. Be able to do very simple algebra and rearrange simple equations: i.e. $F=ma$ is the same as $m=F/a$

a) Solve for T in the equation $PV=nRT$.

b) Insert variables: for example

Given $PV = nRT$ and $n = g/MW$ solve for MW

c) Solve for T_2 if given:

Argon is an inert gas used in light bulbs to retard the vaporization of the filament. A certain light bulb containing argon at 120 atm and 18° C is heated until the pressure reaches 150 atm. Calculate its final temperature in Celsius.

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

- Students have a hard time when the variable is in the denominator.
- Students have a hard time when the values are given in a word problem.

d) Solve for x

$$\frac{ab}{(x^2)} = y$$

5. Understand the order of operations in a multi-step equation:

i.e. $\%error = ((accepted\ value - experimental\ value)/accepted\ value) \times 100$

AND be able to analyze that equation and understand why they might get either a negative or positive result.

6. Translating percent into a fraction to be useful in a conversion problem

7. Unit conversions from word problems. Students often refuse to take time to write down their units and make them cancel so are constantly multiplying or dividing the wrong numbers.

8. How to deal with negative signs:

a) $H = (A+B+C) - (4 + X)$ solve for X

b) Calorimetry:

$$m_1 \times c_1 \times (T_1 - T_2) = -m_2 \times c_2 \times (T_2 - T_3) \text{ Solve for } T_2$$